

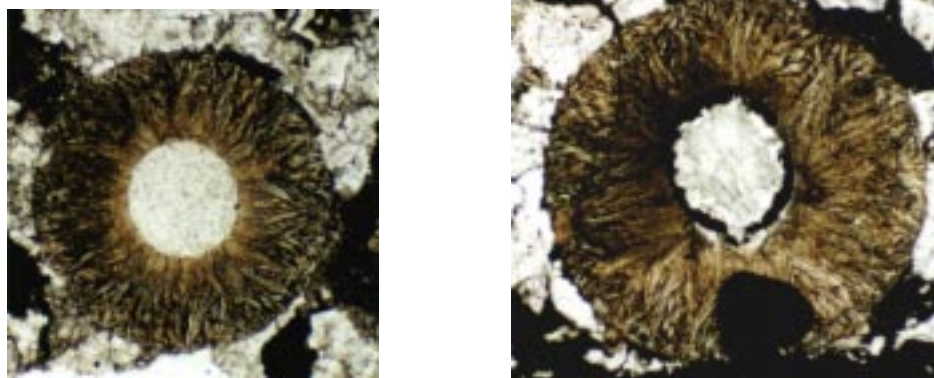
**DISCOVERY OF A NEOARCHEAN IMPACT SPHERULE HORIZON IN THE TRANSVAAL SUPERGROUP OF SOUTH AFRICA AND POSSIBLE CORRELATIONS TO THE HAMERSLEY BASIN OF WESTERN AUSTRALIA;** Bruce M. Simonson, Geology Department, Oberlin College, Oberlin OH 44074-1044 (bruce.simonson@oberlin.edu); Nicolas J. Beukes, Department of Geology, Rand Afrikaans University, Auckland Park 2006, Johannesburg, South Africa (njb@rau3.rau.ac.za); and Scott Hassler, Department of Geological Sciences, California State University, Hayward, CA 94542 (shassler@best.com)

The Hamersley Basin of Western Australia and the Transvaal Supergroup of South Africa constitute two of the best-preserved Neoarchean to Paleoproterozoic volcanic and sedimentary successions on earth. Their many similarities have led to the suggestion that they were originally part of a single continental landmass [1,2]. Detailed studies of strata in the Hamersley Basin revealed several horizons with well-preserved impact spherules (microkrystites), at least one of which is regionally extensive [3,4]. To test the proposed correlation of these two successions, we initiated a search for possible correlatives of the Hamersley spherule layers in the Transvaal Supergroup in 1995 and succeeded in locating a single spherule-bearing horizon in the northern part of the Griqualand West basin, which occupies the southwestern edge of the Kaapvaal craton. Within the Lokamonna Formation of the Schmidtsdrif Subgroup [5], we identified spherules at a constant stratigraphic level in cores from two different sites and in surface exposures at a third site. These three sites lie at the apices of a roughly equilateral triangle with an area of approximately 9,000 km<sup>2</sup>. The nature of the horizon varies considerably from one locality to another, but at all of these sites, the spherules range up to ca. 1 millimeter in diameter, consist of K-feldspar with lesser quartz and muscovite and/or are replaced by carbonate, and display inward-radiating fibrous quench and devitrification textures typical of microkrystites from well-documented impact ejecta such as the K/T boundary layer [6,7] and the North American strewnfield [8]. Thin tuff beds are present in the same stratigraphic succession as the spherule layer [9] and contain spheroidal clasts, many of which are ca. 1 mm in diameter, but they display the finely clastic textures and crude concentric layering diagnostic of accretionary lapilli [10]. Not only are the spherules petrographically distinctive and identical to one another at the different sites, they are very similar to the Hamersley spherules of Western Australia [Fig. 1]. Zircons from tuff interbeds that have been dated radiometrically also indicate they are very similar in age. Tuffs in the general stratigraphic vicinity of the spherule horizon in the Griqualand West succession yielded dates of about 2.55 Ga [11,12], and the spherule bed in the Wittenoom Formation of the Hamersley Group is located ca. 70 m stratigraphically above a tuff that yielded an age of 2.56 Ga [13]. The spherule-bearing layers in both the Wittenoom and Lokamonna Formations occur in the midst of distal or deep shelf deposits, yet display characteristics requiring deposition under the influence of high energy waves. Hassler et al. [14] attributed the structures in the Wittenoom spherule layer to impact-generated tsunami waves. Sedimentary structures in the Lokamonna spherule layer (especially dune-like bedforms up to 1 meter thick and 10's of meters in wavelength overlain by a layer of fine carbonate sand up to 45 cm thick displaying excellent hummocky cross-stratification) suggest a similar interpretation may apply to it as well. In summary, we suggest the recently discovered spherule layer in the Transvaal Supergroup was deposited over a wide area essentially instantaneously by a unique, high-energy event related to an extraterrestrial impact and is correlative to one of the spherule layers in the Hamersley Basin of Western Australia. If this is confirmed by subsequent investigations, it will validate both the long-standing suggestion that these two successions are correlative and the use of impact ejecta layers for precise, intercontinental correlation of early Precambrian strata.

One problem in correlating the newly discovered spherule layer in the Lokamonna Formation to Western Australia is that three spherule layers have been identified in the Hamersley Basin succession. Two of the spherule layers are in the Hamersley Group and have been reported previously. One is in the Wittenoom Formation and shows a number of similarities to the Lokamonna layer as noted above. The second spherule layer is in the S4 macroband of the Dales Gorge Member of the Brockman Iron

Formation [3] and appears to be significantly younger. Zircons from a tuff in the S13 macroband (which is ca. 70 meters higher in the Dales Gorge Member) yielded an age of 2.47 Ga [cited in 4]. The third spherule layer was found in the upper few meters of the Jeerinah Formation of the Fortescue Group by Darian Davies in 1996. This layer is only 1.2 centimeters thick and is only known from one core at present, but its spherules are petrographically similar to those from the Wittenoom and Lokamonna Formations. An age of close to 2.63 Ga was recently obtained from two tuff layers right near the top of the Jeerinah Formation [13]. While this suggests the Jeerinah spherule layer is too old to correlate with the Lokamonna spherule layer, this may not be the case. A tuff in the Gamohaan Formation of the Griqualand West basin recently yielded an age of 2.52 Ga [15]. Given that the Gamohaan Formation is separated from the underlying Lokamonna Formation by 1,000 to 2,000 meters of strata (mainly platform carbonates) [5,16], the Lokamonna spherule layer may be significantly older than the 2.55 Ga cited above. More work is needed to firmly establish which (if any) of the Hamersley spherule layers is contemporaneous with the Lokamonna spherule layer. It is also very likely that there are more spherule layers out there waiting to be discovered in early Precambrian sedimentary sequences, provided they were deposited in relatively deep, quiet water and escaped subsequent deformation.

**References:** [1] Button A. (1976) *Min. Sci. Eng.*, 8, 262-293. [2] Cheney E.S. (1996) *Precambrian Research*, 79, 3-24. [3] Simonson B.M. (1992) *GSA Bull.*, 104, 829-839. [4] Simonson B.M. and Hassler S.W. (1997) *Austral. Jour. Earth Sci.*, 44, in press. [5] Beukes N.J. (1987) *Precambrian Research*, 54, 1-46. [6] Bohor B.F. and Glass B.P. (1992) *Meteoritics*, 30, 182-198. [7] Smit J., Alvarez W., Montanari A. Swinburne N., Van Kempen T.M., Klaver G.T. and Lustenhouwer W.J. (1992) *LPSC XXII*, 87-100. [8] Glass B.P. (1989) *Meteoritics*, 24, 209-218. [9] Beukes N.J. (1980) *Trans. Geol. Soc. So. Afr.*, 83, 141-170. [10] Altermann W. (1996) *Precambrian Research*, 79, 73-100. [11] Barton E.S., Altermann, W., Williams I.S., and Smith C.B. (1994) *Geology*, 22, 343-346. [12] Altermann, W. (1996) *So. Afr. Jour. Geol.*, 99, 337-338. [13] Trendall A.F., Nelson D.R., de Laeter J.R. and Hassler S.W. (1997) *Austral. Jour. Earth Sci.*, 44, in press. [14] Hassler S.W., Robey H.F., Davies D. and Simonson B.M. (1996) *LPSC XXVII*, 503-504. [15] Sumner D.Y. and Bowring, S.A. (1996) *Precambrian Research*, 79, 25-35. [16] Altermann W. and Wotherspoon J. McD. (1995) *Min. Deposita*, 30, 124-134.



**Fig. 1.** Photomicrographs in plane polarized light of similar spherules from Lokamonna (right) and Wittenoom (left) Formations of Hamersley and Transvaal respectively. Both display an outer shell of radial fibrous K-feldspar and a core of finely crystalline muscovite plus carbonate replacement. Both are encased in unaltered dolomite (clear) and pyrite (opaque) as they are fresh samples from drillcores. Diameter of spherule on left is 0.72 mm and the scale is the same in both photomicrographs.